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The Effect of Different Levels of Irrigation and Nitrogen Fertilizer on Yield and Water Use Efficiency of Potato in Subsurface Drip Irrigation

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Introduction: After wheat, rice and corn, potato is the fourth most important food plant in the world. In comparison with other species, potato is very sensitive to water stress because of its shallow root system: approximately 85% of the root length is concentrated in the upper 0.3-0.4 m of the soil. Several studies showed that drip irrigation is an effective method for enhancing potato yield. Fabeiro et al. (2001) concluded that tuber bulking and ripening stages were found to be the most sensitive stages of water stress with drip irrigation. Water deficit occurring in these two growth stages could result in yield reductions. Wang *et al.* (2006) investigated the effects of drip irrigation frequency on soil wetting pattern and potato yield. The results indicated that potato roots were not limited in wetted soil volume even when the crop was irrigated at the highest frequency while high frequency irrigation enhanced potato tuber growth and water use efficiency (WUE). Though information about irrigation and N management of this crop is often conflicting in the literature, it is accepted generally that production and quality are highly influenced by both N and irrigation amounts and these requirements are related to the cropping technique. Researches revealed that nitrogen fertilizers play a special role in the growth, production and quality of potatoes.

Materials and Methods: A factorial experiment in randomized complete block design with three replications was carried out during two growing seasons. Studied factors were irrigation frequency (I1:2 and I2:4 days interval) and nitrogen fertilizer levels (applying 100 (N1), 75 (N2) and 50 (N3) % of the recommended amount). Nitrogen fertilizer was applied through irrigation water. In each plot two rows with within-and between-row spacing of 45 and 105 cm and 20 m length. The amount of nitrogen fertilizer for the control treatment was determined by soil analysis (N1). In all treatments, nitrogen fertilizer applied in 5 times until flowering stage. Potassium, phosphorus and microelements applied according to the soil analysis results. The subsurface drip tape was used for irrigation. Tapes with 300 µm thickness, 30 cm dripper spacing and 4 lit/hour discharge were applied. Tapes buried at 20 cm soil depth before planting. Water amount was measured by the volume meter at each irrigation treatment. Water amount calculated based on crop water requirement and plot area and irrigation frequency. On maturity stage, 8 m of two central rows of each plot harvested for determining tuber yields. Water use efficiency was calculated as the ratio of the tuber yield to the total consumed water volume. Statistical analysis was performed using MSTAT-C software. Means were compared by Duncan's multiple range tests at 0.05 and 0.01 significant levels.

Results and Discussion: Results of combined analysis showed that yield and water use efficiency (WUE) did not affected by irrigation frequency. Yield and water use efficiency affected by nitrogen level ($p<0.05$) and interaction between treatments ($p<0.01$). Yield and WUE of potato in irrigation intervals 2 and 4 days were 29.789, 27.765 ton/ha and 4.006 and 3.728 kg/m3, respectively with no significance difference. The yield in 100, 75 and 50 % of Nitrogen amounts was 31.167, 29.275 and 25.875 ton/ha, respectively that had significant difference. The highest WUE observed in applying 100% N at a rate of 4.183 kg/m3 while in 75% and 50% treatments were 3.933 and 3.483 kg/m3, respectively. The highest and lowest yield and water use efficiency were obtained of I2N1 and I2N3 treatments, respectively.

Conclusion: The effect of irrigation frequency treatment on yield and water use efficiency was not significant. The results of the combined analysis showed that the effect of nitrogen and interaction of nitrogen and irrigation frequency on yield and water use efficiency was significant. In 4 days intervals, glands have an opportunity to fill and weight gain. But in 2 days intervals are more likely to produce the number of tubers. However, given that the number of tubers over 50 grams in 4 days intervals was more than 2 days, to achieve better quality and marketability of the product, 4 daysintervals was preferred to 2 days intervals. Despite the

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lower fertilizer use in the treatment of 75% N compared to 100% N, the tuber yield in 75% N treatment was more than the 100% N treatment. Therefore, applying subsurface irrigation with 4 days intervals combined by using 75% of recommended nitrogen fertilizer resulted in high marketable, yield and WUE in potato.

Keywords: Subsurface Drip irrigation, Potato, Irrigation interval, Nitrogen